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ABSTRACT

This document reports on a series of visual scanning studies done with Israeli preschoolers and kindergartners to resolve issues related to diagnostic test and instructional materials design. The first study assessed the effect of item content on error rate. Three multiple-choice tests, differing only in item content, were given to 38 kindergartners. The second study assessed scanning preferences of 80 preschoolers and kindergartners by a picture naming task. A significant increase in both uniformity and in right-to-left scanning was found between nursery and preschool subjects, but not between preschoolers and kindergartners. Preschoolers showed low uniformity and no clear directional preference. The third study explored directional preferences for visual scanning through a multiple choice format with two correct alternatives. Each of 80 subjects received two versions of each test: one with target to the left of a horizontal row of alternatives and one with target to the right. The alternative closest to the target was preferred consistently, showing target position to be the major determinant of scanning direction in such formats. The fourth study explored the effect of target position on order reversal errors using (two formats of) the letter matching test: target to the left of horizontally arranged alternatives and target to the right. No significant difference was found in reversal errors for the two positions. (Author/SB)

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visual scanning habits of israeli kindergartners

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WISCONSIN RESEARCH AND DEVELOPMENT CENTER FOR COGNITIVE LEARNING

Technical Report No. 363

VISUAL SCANNING HABITS OF ISRAELI KINDERGARTNERS

by

Richard L. Venezky and Yael Shiloah

Report from the Project on
Conditions of School Learning and Instructional Strategies

Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
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ABSTRACT

A series of visual scanning studies was done with Israeli preschoolers and kindergartners to resolve several issues related to the design of diagnostic tests and instructional materials. In the first study the effect of item content on error rate was assessed by giving each of 38 kindergartners three multiple-choice tests which differed only in item content (Hebrew letters, familiar pictures, and geometric forms). No item content effect was found either by an analysis of variance, or by test correlations.

In the second study, the scanning preferences of 80 preschoolers and kindergartners were assessed by a picture naming task. Ss were asked to name pictures arranged in horizontal groups of three. A significant increase in both uniformity (consistent left-to-right or right-to-left naming) and in right-to-left scanning was found between nursery and preschool Ss, but not between preschoolers and kindergartners. Preschoolers showed low uniformity and no clear directional preference.

In the third study, directional preferences for visual scanning were explored through a multiple choice format with two correct alternatives. Each of 80 Ss received two versions of each test: one with the target to the left of a horizontal row of alternatives and one with the target to the right. The alternative closest to the target was preferred consistently, thus showing that target position is the major determinant of scanning direction in such formats.

In a fourth study, the effect of target position on order reversal errors was explored, using the letter matching test from the first study. Thirty-five kindergartners received the test in two formats: target to the left of horizontally arranged alternatives and target to the right. No significant difference was found in reversal errors for the two target positions.

I

INTRODUCTION

The design of diagnostic tests and instructional materials is often based on assumptions which the designers cannot afford to validate experimentally. In testing visual matching ability, for example, prereading tests in the United States tend to use multiple-choice formats. Pupils are given a target which is placed to the left of the alternatives and told to match against that sample. Furthermore, the test items are most often letters and letter strings. All of this seems quite logical, yet when translated to another culture the logic can come into question. For example, is the target placed to the left in tests given in the United States so that the implied direction of scanning matches that of English writing? If so, should a Hebrew test have the target placed to the right of the alternatives? What evidence do we have that children scan in the direction we assume in such tests? Braine (1968), among others, claims that all persons might have a natural preference for scanning from left to right, due perhaps to hemispheric lateralization. She goes on to postulate, however, that there are developmental changes in the direction of scanning in Israeli children, with a shift in preference from the right to the left side occurring around the age of twelve. Her experimental data do not, however, give strong support to this notion. Studies by Orbach (1967) and Daves and Werzberger (1971), which compared responses to briefly exposed Hebrew and English words and letters, failed to establish a clear difference in visual field preferences. Because of concerns such as these, a series of studies was initiated to resolve several developmental questions.

II

STUDY 1: ITEM CONTENT AND ERROR RATE

METHOD

The effect of item content on error rate in visual matching tasks has never been explored thoroughly, especially in relation to order errors. Gates (1921) found that errors in matching letters related more highly to later reading success than did errors in matching geometric forms, but it is not clear from his data how similar the two tests were in format. To explore this problem, three multiple-choice tests were constructed, one with Hebrew letters, one with familiar pictures and one with geometric forms. Each test consisted of 15 items and each item consisted of a target plus three alternatives centered on a horizontal line below the target. Targets and alternatives were constructed of three units each (that is, either three letters, or three forms, or three pictures). The alternatives for each item consisted of an exact match, a complete order reversal, and a dissimilar string. All three tests contained identical item formats; they differed only in item content.

SUBJECTS

The subjects were 38 Israeli kindergarten children, selected from 7 classrooms in middle (M) and (LM) lower-middle socioeconomic (SES) status neighborhoods. Their ages varied from five years and three months to six years and three months at the time of testing. All children took all three tests.

RESULTS AND DISCUSSION

An initial analysis of variance showed no significant effect for either sex or SES. The data were then pooled and three types of analyses were performed on the test scores shown in Table 1: an analysis of variance, rank order correlations on individual scores, and rank order correlations on group scores. The results of the analysis of variance were not conclusive. Differences between the dependent variables (an effect of test content) were significant for $p < .05$, but not for $p < .025$. Using the relation $\theta^2 = \frac{\text{mean square (mode)} - \text{mean square (error)}}{N}$ the amount of variance associated with test content accounted for only 17 percent of the total variance.

TABLE 1

CORRECT RESPONSES TO PICTURES, GEOMETRIC FORMS, AND LETTERS ACCORDING TO POSITION OF CORRECT ALTERNATIVE

		Position						
		Right (1)		Middle (2)		Left (3)		
		Total	%	Total	%	Total	%	N
M	Pictures	30	52.6	105	92.0	33	58.0	19
	Geometric forms	22	40.7	94	87.0	22	40.7	18
	Letters	25	46.3	99	91.6	24	44.5	18
	Total	77	46.7	298	90.4	79	47.9	55
ML	Pictures	26	45.6	105	92.0	25	43.9	19
	Geometric forms	20	35.1	96	84.3	18	31.6	19
	Letters	23	42.6	102	94.5	23	42.6	18
	Total	69	41.0	303	90.2	64	38.1	56

A second attempt to evaluate the effect of test content involved ranking each child according to his or her score on each test, and then computing a coefficient for the correlation between letter-test rank and the average of picture- and geometric-test ranks. (Thirty-five Ss completed all three tests.) By this method the Pearson product-moment correlation coefficient was 0.82, Kendall's Tau was estimated at 0.55, and Goodman and Kruskal's Gamma was 0.69. All three scores indicate that the rankings are closely associated and therefore test content did not interact with individuals.

The third analysis correlated average number of correct responses on pairs of tests, using group scores. The correlation between letter and picture tests was .74; letter and geometric forms, .76; and picture and geometric forms, .65. All are high and indicate close relationships between tests. Therefore, test content was not found to have a major effect upon the ability of kindergartners to match the types of items used in these tests.

III

STUDY 2: SCANNING PREFERENCES--FREE CHOICE

In a study cited above, Braine (1968) found a tendency for Israeli college students to show greater accuracy for the left visual field, just as American college students did. From a series of matching and scanning tasks, she concluded that Israeli students at the third grade level prefer to attend to the right side of a visual array, but by seventh grade their preference shifts to the left. If these results held for kindergarten children, that is, if children at this level preferred to attend to the right side of a visual array, then the design of prereading tests might need to take this bias into account. A task was therefore designed to assess directional preferences of Israeli preschool and kindergarten children.

METHOD

Eleven stimuli were constructed from a pool of eight common pictures by arranging three pictures on a horizontal line on each stimulus card. Pictures were selected randomly with the constraint that no picture could occur more than once on a single card. An attempt was also made to balance the distribution of pictures across stimuli by position (left, middle, right).

Children were pretrained on identification of the eight pictures. They were then shown the stimulus cards one by one and asked to name each picture. The order in which the pictures were named was recorded.

SUBJECTS

A total of 80 subjects in five age-SES groups were tested, varying in average age from three years and four months to five years and eight months. (See Table 2; the disparity in number of subjects was caused by the lack of available subjects in the lowest age group.)

RESULTS

In contrast to the Braine study, scores were calculated for the complete response rather than just the position of the first picture named. All responses were classed as either uniform left-right, uniform right-left, or irregular. Uniform left-right required that the pictures be

TABLE 2

MEAN UNIFORMITY SCORES
(Maximum score is 11)

Group	Type*	N	$\bar{X}$ R-L	$\bar{X}$ L-R
A	Nursery	13	3.69	3.23
B	Pre-High	17	7.12	2.59
C	Pre-Low	18	8.00	2.33
D	K-High	14	8.00	1.43
E	K-Low	18	6.39	3.50

*Pre = Pre-Kindergarten; K = Kindergarten; High = High SES; Low = Low SES.

named in the order left, middle, right; uniform right-left required a right, middle, left response. Any other sequence was classed as irregular. The means for the two uniformity classes are shown in Table 2. Independent t-tests comparing high and low pre-kindergarten groups (B and C) and high and low kindergarten groups (D and E) showed insignificant differences for both uniformity scores. SES groups were then combined, giving three groups differing primarily in age, as shown in Table 3.

TABLE 3

MEANS FOR COMBINED GROUPS

	Average Age (Months)	N	$\bar{X}$ R-L	$\bar{X}$ L-R
Nursery (A)	40.0	13	3.69	3.23
Preschool (B, C)	55.5	35	7.57	2.46
Kindergarten (D, E)	68.5	32	7.09	2.59

Preschoolers did not differ significantly from kindergartners on either measure, but nursery school pupils differed significantly from both preschoolers and kindergartners on right-left (but not left-right) uniformity.

DISCUSSION

Although the three groups are not strictly comparable either in size or SES composition, several trends should be noted. The first is the large jump in right-left uniformity between nursery- and preschool-aged children, especially in relation to the insignificant change in left-right uniformity across the three groups. Thus, all of the increase in general scanning uniformity is attributable to an increased preference for right to left scanning. The most plausible explanation for this change is an awareness of the direction of scanning for Hebrew. An analysis of individual scores for kindergarten children in group E (N = 18) showed that 10 children scanned right to left on 8 or more of the stimuli while only 4 children scanned left to right on 8 or more stimuli. None of these latter children came from homes in which a non-Hebrew orthography was read with any frequency, hence the preference appears to be idiosyncratic.

A second factor to note is the low uniformity of the nursery group and their lack of any clear preference for scanning direction. The change from nursery to preschool is thus both in higher uniformity and higher preference for right to left scanning. Both of these results appear to conflict with the conclusions drawn by Braine (1968); however, her procedures and subjects differed from those used in this study. A replication of the present study at grades one through eight is needed to obtain consistent developmental data.

IV

STUDY 3: SCANNING PREFERENCES--FORCED CHOICE

In the study just discussed a clear preference for right to left scanning was found in Israeli kindergartners. Since this preference might affect the results obtained from matching against a sample when alternatives are aligned horizontally, a study was designed to evaluate how scanning preference might interact with target position.

SUBJECTS

Ss were 16 kindergartners (10 males, 6 females) with an average age of 68 months. All children were enrolled in an Israeli public kindergarten.

METHOD

Each stimulus item consisted of a standard plus three alternatives. Two alternatives were identical to the standard; one was quite different:

אבת לוע אבת אבת

Each standard and alternative was composed of three Hebrew letters printed in a block script commonly used in kindergarten. Four different standards were constructed and for each, three different sets of alternatives were generated by varying the position of the dissimilar alternative. This yielded 12 test items. In test A the standard was placed to the left of a horizontal row of alternatives and in test B, to the right. Otherwise the items were identical. For each test a single, random ordering was generated.

Ss were assigned randomly to one of two test sequences, and tested over a two day period. For each item, S was told to point to the first letter group that he saw which was exactly like the standard. E recorded the position of the alternative which was selected first. If S indicated a second alternative which he stated was also correct, its position was also recorded, but only the positions of the alternatives selected first were analyzed.

RESULTS AND DISCUSSION

Of the 384 responses, 8 were incorrect, giving 97.2 percent correct responses. (Seven of the errors occurred when the standard was on the

right; all eight errors involved selection of the alternative closest to the standard.) The distributions of responses for each test are shown in Table 4.

TABLE 4

TOTAL RESPONSES
(N = 16)

Position of Standard	Position of Correct Choices		Position of Incorrect Choices
	Right	Left	
left	32	159	1
right	169	16	7

Chi-square tests performed on the distributions of correct choices for each standard position showed significant deviations ($p < .001$) from chance distributions. The probability of selecting the closest correct alternative when the standard is on the right is 88 percent, while the comparable probability for the standard on the left is 83 percent. This slight advantage for the right standard might be due to the right to left scanning preference shown in the previous study. However, a comparison of scores for the 16 Ss who received both the picture naming task and this task did not reveal a consistent pattern for the four Ss who had high left to right uniformity in picture naming. Therefore, the hypothesis that target position is the primary determinant of scanning direction appears to be strongly supported.

V

STUDY 4: SCANNING DIRECTION AND ORDER REVERSAL ERRORS

In the last study the position of the target relative to the alternatives appeared to control the order in which the alternatives were scanned, at least in respect to the selection of the correct match. However, the possibility remains that order reversal errors may be induced more by one target position than by another, even though the total number of errors may be constant. To assess this possibility two further letter matching tests were constructed. Both were composed of the identical 15 items used in the item content study, except that in one test the target was to the left of the alternatives, and in the other to the right.

SUBJECTS

The subjects were the 35 kindergartners tested in the item content study who completed all three content tests.

METHOD

Both tests were administered in a single sitting, but half of the Ss were randomly assigned to one testing order and half to the other. The instructions were identical to those given in Study 3.

RESULTS AND DISCUSSION

Since the position of the reversed alternative relative to the correct one affects children's responses, the results are given in percentages, based upon whether the target was nearer to the correct response (TNC) or nearer to the reversal (TNR). From Table 5 it can be seen that the probabilities of reversal errors are nearly identical for both target positions on both TNR and TNC items. Hence there is no advantage to either target position in terms of reversal errors. Since the rate of dissimilar (nonmatching) responses is nearly equal for the two target positions (left and right) and for the two arrangements relative to the target (TNC and TNR), the only major difference is between the ratio of correct and reversal choices for the two target positions.

TABLE 5

CORRECT, REVERSAL, AND DISSIMILAR RESPONSES TO THE TWO TESTS (PERCENTAGES)

	Target Position	
	Left	Right
TNC		
Correct	71.8	71.8
Reversal	7.2	7.8
Dissimilar	21.0	20.4
TNR		
Correct	50.0	52.9
Reversal	30.8	31.8
Dissimilar	19.2	15.3

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